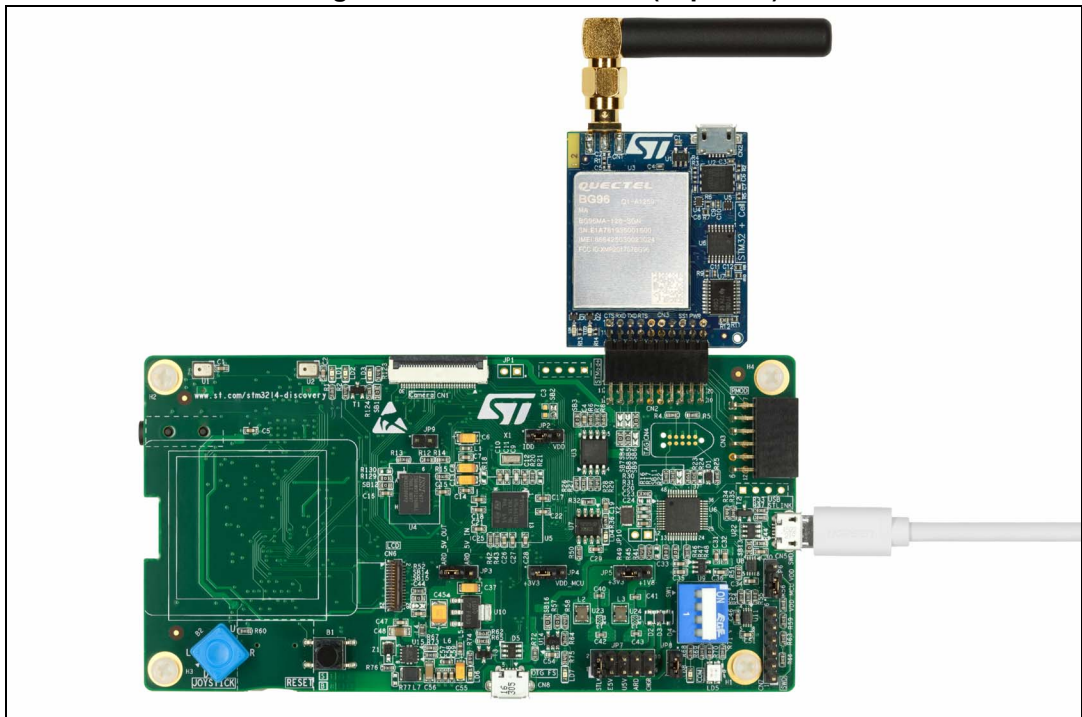


STM32 Discovery pack for LTE IoT cellular to cloud

Introduction

The STM32 Discovery pack (P-L496G-CELL02) is a turnkey development platform for cellular and cloud technology based solutions. The pack contains an STM32L496AGI6-based low-power Discovery mother board and an STMod+ Cellular LTE IoT worldwide expansion board with antenna.

Figure 1. P-L496G-CELL02 (Top view)



1. Picture is not contractual.

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1 Features

- STM32L496AGI6 Arm^{®(a)}-based microcontroller featuring 1 Mbyte of Flash memory and 320 Kbytes of RAM in a UFBGA169 package
- USB OTG HS
- On-board current measurement
- SAI Audio CODEC
- ST-MEMS digital microphones
- 8-Mbit PSRAM
- 2 user LEDs
- 1 user and 1 reset push-buttons
- 4-direction joystick with selection button
- Board connectors:
 - Camera 8 bit
 - USB with Micro-AB
 - Stereo headset jack including analog microphone input
 - microSD™ card
- Board expansion connectors:
 - Arduino™ Uno V3
 - STMod+
- Board expansion features:
 - Quectel BG96 worldwide cellular modem LTE Cat M1/Cat NB1/EGPRS module 300 kbps downlink, 375 kbps uplink
 - Modem reset red LED and modem signaling green LED
 - Switchable SIM interface, eSIM and micro SIM
 - Pulse SMA antenna for frequency ranges: 824 / 900 / 1800 / 1900 / 2100 MHz
This antenna may not be suitable for your LTE Band, please use at that time the SPDA24700 antenna from Pulse
- Flexible power-supply options: ST-LINK, USB V_{BUS} , or external sources
- On-board ST-LINK/V2-1 SWD, TAG debugger/programmer with USB re-enumeration capability: mass storage, virtual COM port and debug port
- Comprehensive free software libraries and examples available with the STM32Cube package
- Support of a wide choice of integrated development environments (IDEs) including IAR™, Keil®, GCC-based IDEs



a. Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 System requirements

- Windows® OS (7, 8 and 10), Linux® 64-bit or macOS®
- USB Type-A to Micro-B cable

3 Development toolchains

- Keil® MDK-ARM^(a)
- IAR™ EWARM^(a)
- GCC-based IDEs including free SW4STM32 from AC6

4 Demonstration software

The demonstration software, included in the STM32Cube MCU Package, is preloaded in the STM32 Flash memory for easy demonstration of the device peripherals in standalone mode. The latest versions of the demonstration source code and associated documentation can be downloaded from the www.st.com web page.

5 Ordering information

To order the P-L496G-CELL02 Discovery pack refer to [Table 1](#).

Table 1. Ordering information

Order code	Target STM32
P-L496G-CELL02	STM32L496AGI6

a. On Windows® only

6 Technology partners

EMNIFY:

- IoT connectivity platform eSIM

QUECTEL:

- Worldwide LTE IoT EGPRS module

EXOSITE:

- Cloud data management

GROVESTREAMS:

- IoT platform

7 Hardware layout and configuration

Figure 2 illustrates the connection between the STM32L496AGI6-based Discovery mother board and the modem expansion board. The connection is done through the STMod+ connector.

7.1 Board layouts

There is no LCD with the STM32L496AGI6-based Discovery mother board in this pack. For mother board detailed description, refer to *Discovery kit with STM32L496AG* user manual (UM2160).

Figure 2. Mother board and expansion LTE IoT modem top view

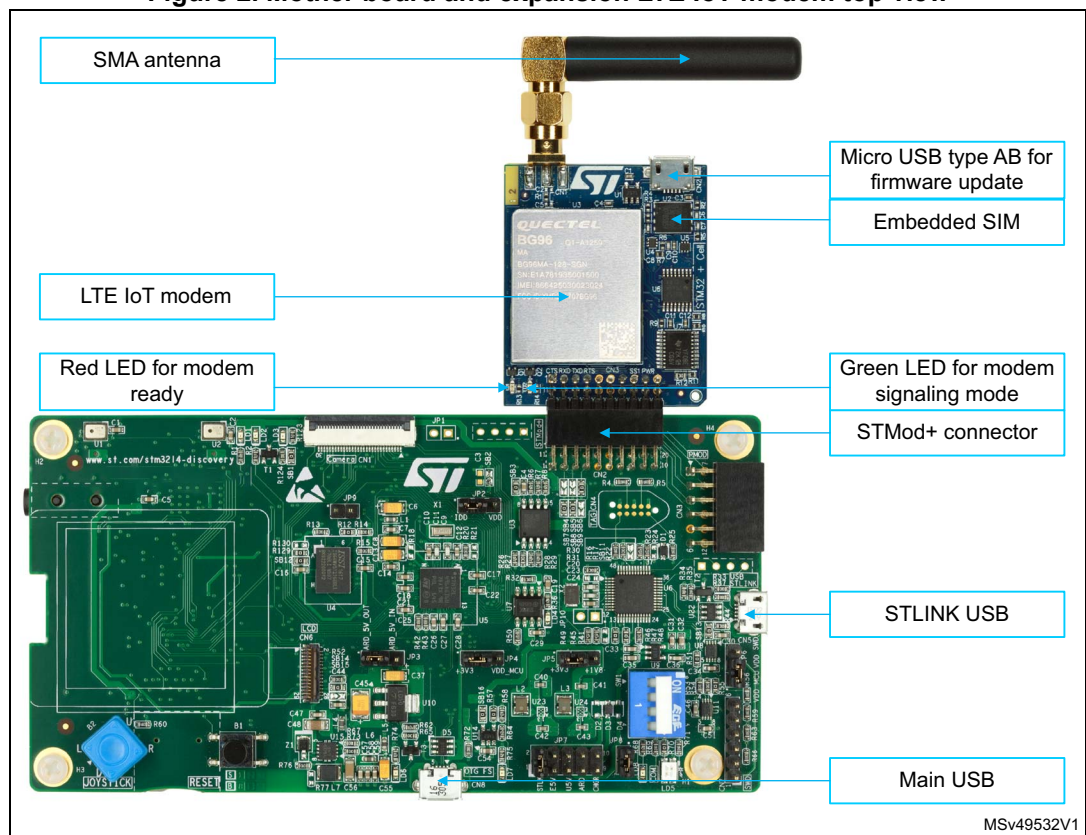
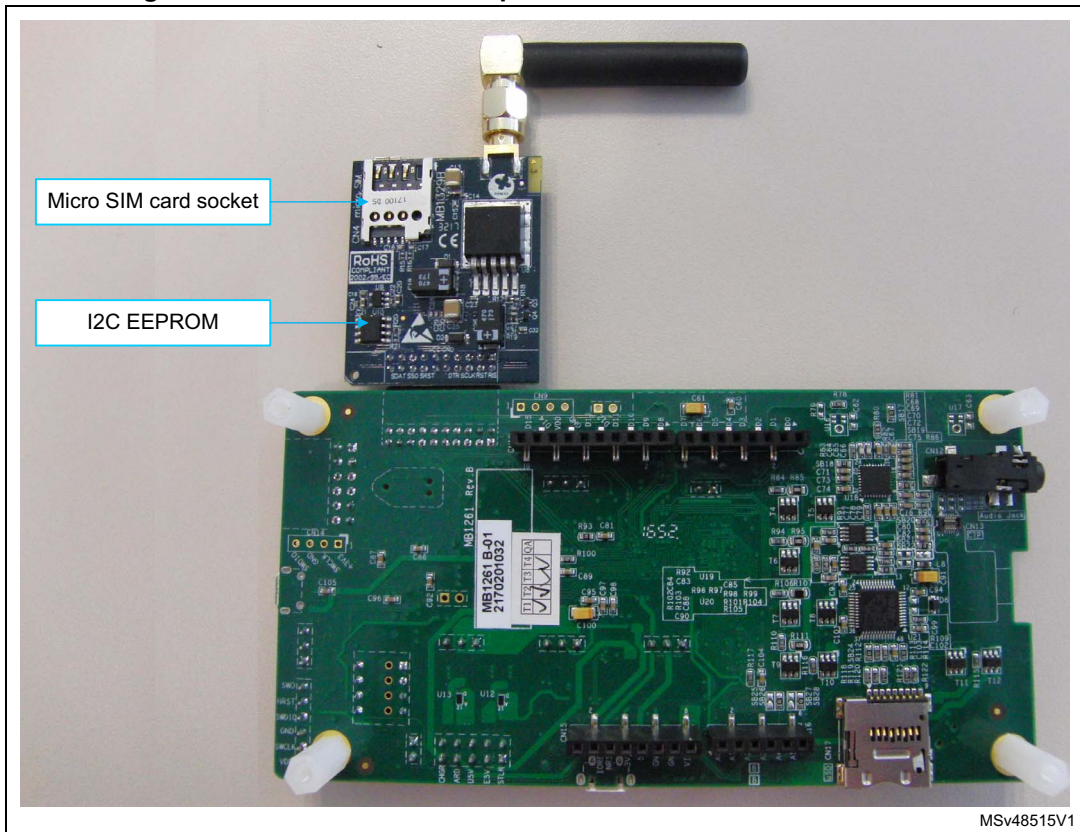


Figure 3. Mother board and expansion LTE IoT modem bottom view



7.2 Cellular STMod+ expansion board

The expansion board is an LTE IoT modem based on Quectel BG96 module. The BG96 is a series of LTE Cat M1/Cat NB1/EGPRS module offering a maximum data rate of 300kbps downlink and 375kbps uplink. The connection with the STM32L496AGI6-based Discovery mother board is done through the STMod+ connector.

Table 2. STMod+ connector pin description

STMod+ IOX=pin x	Pin name	Pin function
pin 1	CTSS	Modem UART CTS
pin 2	RXDS	Modem UART RXD
pin 3	TXDS	Modem UART TXD
pin 4	RTSS	Modem UART RTS
pin 5	GND	Ground
pin 6	VCC	+5V
pin 7	STMod+ IO7	I2C clock for EEPROM
pin 8	Sim_select1	Sim selection IO1 always set to 1
pin 9	PWRen	Modem power enable

Table 2. STMod+ connector pin description (continued)

STMod+ IOX=pin x	Pin name	Pin function
pin 10	I2C	I2C data for EEPROM
pin 11	RIS	Modem ring indicator RI
pin 12	RST	Modem reset
pin 13	sim_CLK	SIM clock
pin 14	DTRS	Modem wake up
pin 15	VCC	+5V
pin 16	GND	Ground
pin 17	Sim_RST	Sim reset
pin 18	Sim_select0	Sim selection IO0, 0 for plastic SIM and 1 for embedded SIM
pin 19	Sim_DATA	Sim data
pin 20	STAS	Modem status

7.2.1 Modem power supply and reset

The cellular board is supplied through the 5V on the STMod+ connector (Pins 6 and 15). The modem is enabled by the power enable (Pin 9). When this pin is driven, a few seconds later, the red led is on to indicate that the modem is ready, and the green led starts flashing to indicate that the modem is scanning for cell synchronization. At this time AT command can be sent using UART.

If the power supply is not enough in signaling mode, additional power supply can be provided by the USB connector.

7.2.2 SIM selection

Switchable SIM interface is provided on the cellular modem board. The user selects either the embedded SIM or the plastic SIM.

Set pin Sim_select0 to low to select the plastic SIM, or to high to select the embedded SIM.

7.2.3 Modem firmware update.

The modem firmware can be updated using the micro USB connector provided on the modem:

1. First install the USB drivers of the modem from Quectel.
2. Install Qflash from Quectel and load the firmware.
3. Press start and reset the modem to download the firmware.

7.3 Embedded ST_LINK/V2-1

The ST-LINK/V2-1 programming and debugging tool is integrated on the STM32L496AGI6-based Discovery mother board. Compared to ST-LINK/V2 the changes are listed in [Section 7.3.1](#).

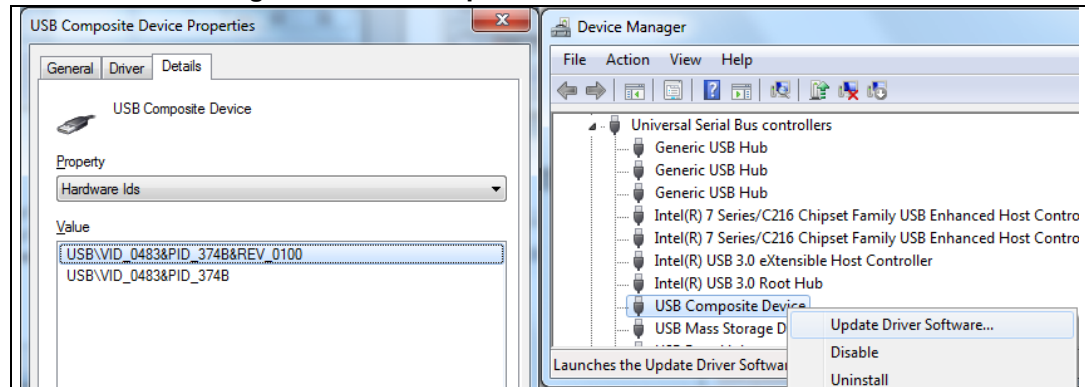
7.3.1 Drivers

The ST-LINK/V2-1 requires a dedicated USB driver, available on www.st.com for Windows 7 and 8. On Windows XP the ST-LINK/V2-1 driver requires WinUSB to be installed before using the ST-LINK/V2-1 (either available from Microsoft website or included in the USB driver for ST-LINK/V2 for XP).

When the STM32L496AGI6-based Discovery mother board is connected to the PC before the driver is installed, some STM32L496AGI6-based Discovery mother board interfaces may be declared as 'Unknown' in the PC device manager. In this case the user must install the driver files, and update the driver of the connected device from the device manager.

Note: Prefer using the 'USB Composite Device' handle for a full recovery.

Figure 4. USB Composite Device driver installation.



7.4 Mother board power supply

7.4.1 Power supply sources

The STM32L496AGI6-based Discovery mother board is designed to be powered by the following sources:

- STLK from the ST-LINK/V2-1 USB connector CN5 with 500 mA current limitation
- Power mechanism of supplying the board by STLINK/V2-1
- Programing/debugging when the power supply is not from ST-LINK/V2-1

It is mandatory to power the board first using user USB FS connector CN8 or the VIN pin of Arduino connector CN15 before connecting the USB cable from ST-LINK/V2-1 CN5 to the PC. Proceeding this way ensures that the enumeration succeeds thanks to the external power source.

The following power sequence procedure must be respected:

1. Put a jumper in JP3 at location U5V to use power from user USB CN8 or at location E5V to use power from VIN of Arduino connector CN15.
2. Connect the corresponding external power source.
3. Check the green LED LD8 is turned ON.
4. Connect the PC to ST-LINK/V2-1 USB connector CN5.

If this order is not respected, the board may be powered by VBUS first from ST-LINK, and the following risks may be encountered:

1. If more than 500 mA current is needed by the board, the PC may be damaged or current may be limited by PC. As a consequence the board is not powered correctly.
2. 500 mA is requested at the enumeration, so there is a risk that the request is rejected and enumeration does not succeed if PC does not provide such current.

7.5 Mother board reset sources

The reset signal of the STM32L496AGI6-based Discovery mother board is low active and the reset sources include:

- Reset button B1
- Embedded ST-LINK/V2-1, SW1 set to ON (default setting)
- Arduino compatible TM connector CN15 pin 3

7.6 Mother board boot options

After reset, the microcontroller STM32L496AGI6 may boot from the 3 following embedded memory locations depending on bits BOOT0 and BOOT1:

- Boot from the user FLASH memory
- Boot from the ICP (In Circuit Programming)
- Boot from the SRAM

The selection of the memory space for the boot is done by two bits, BOOT0 and BOOT1. The value of BOOT1 is defined by a user option bit (bit[23], nBOOT1). Specifically, when this bit is written with '1', the empty flag status toggles and keeps this new status until the next OBL or until a new '1' is written.

Table 3. Boot settings

nBOOT1 (OPTR[23])	nBOOT0 (OPTR[27])	BOOT0 pin (PH3)	BOOT0 SW configuration OPTR[26])	Main Flash empty	Boot memory space alias
X	X	0	1	0	User FLASH memory is aliased at address 0x0000_0000
X	X	0	1	1	Test FLASH memory is aliased at address 0x0000_0000
1	X	1	1	X	Test FLASH memory is aliased at address 0x0000_0000

Table 3. Boot settings (continued)

nBOOT1 (OPTR[23])	nBOOT0 (OPTR[27])	BOOT0 pin (PH3)	BOOT0 SW configuration OPTR[26])	Main Flash empty	Boot memory space alias
0	X	1	1	X	Embedded SRAM is aliased at address 0x0000_0000
1	1	X	0	X	User FLASH memory is aliased at address 0x0000_0000
1	0	X	0	X	Test FLASH memory is aliased at address 0x0000_0000
0	0	X	0	X	Embedded SRAM is aliased at address 0x0000_0000

8 P-L496G-CELL02 Information

On some P-L496G-CELL02, the BG96 modem may remain in test mode. Therefore it is necessary to put the modem in signaling mode to be able to connect to a cellular network for the first time.

It concerns only the modems shipped with the following firmware revision:
BG96MAR02A05M1G

If the user is unable to connect to a cellular network with the BG96MAR02A05M1G firmware, he must send the AT command "AT+CFUN=1" to the modem.

The user may run the demonstration software preloaded in the discovery board to do that:

1. Open a terminal on the PC (Tera Term).
2. Connect the BG96 to the discovery board.
3. Connect the discovery board to the PC using the OTG FS USB connector CN8.
4. Reset the discovery by pressing the reset button B1, and press the joystick UP button until the following message appears to indicate that the user may send AT commands to the BG96 modem:
 - Welcome to STM32-Cellular to Cloud (STM32-C2C)
 - AT commands terminal: connection to PC with USB-OTG FS is needed.
 - Modem is using eSIM.

 - RDY
 - AT terminal ready... Press the joystick button to restart the AT terminal using the Micro SIM (if present).
 - AT+CMEE=2

 - OK
 - ATE1

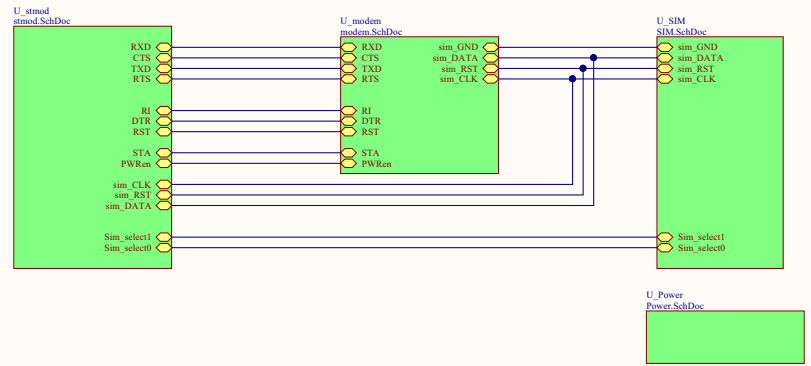
 - OK
5. Verify the firmware revision by typing "at+cgmr", if the firmware is BG96MAR02A05M1G, please follow the next step.
6. Put the modem in signaling mode by entering the command "AT+CFUN=1", the modem must respond OK.
7. Confirm that the modem is in signaling mode by entering the command "AT+CFUN?", the modem must respond +CFUN: 1.
8. This operation must be performed only once.

Appendix A Expansion board schematics

This section provides design schematics for the cellular expansion board:

- [Figure 5: Expansion board top level](#)
- [Figure 6: Expansion board modem](#)
- [Figure 7: Expansion board SIM](#)
- [Figure 8: Expansion board STMod+](#)
- [Figure 9: Expansion board power](#)

Figure 5. Expansion board top level



Title: MBI329_TOP	
Project: C2C	
Variant: (Use Variations)	
Revision: B-02	Reference: MBI329
Size: A4	Date: 01-JAN-16
	Sheet: 2 of 6


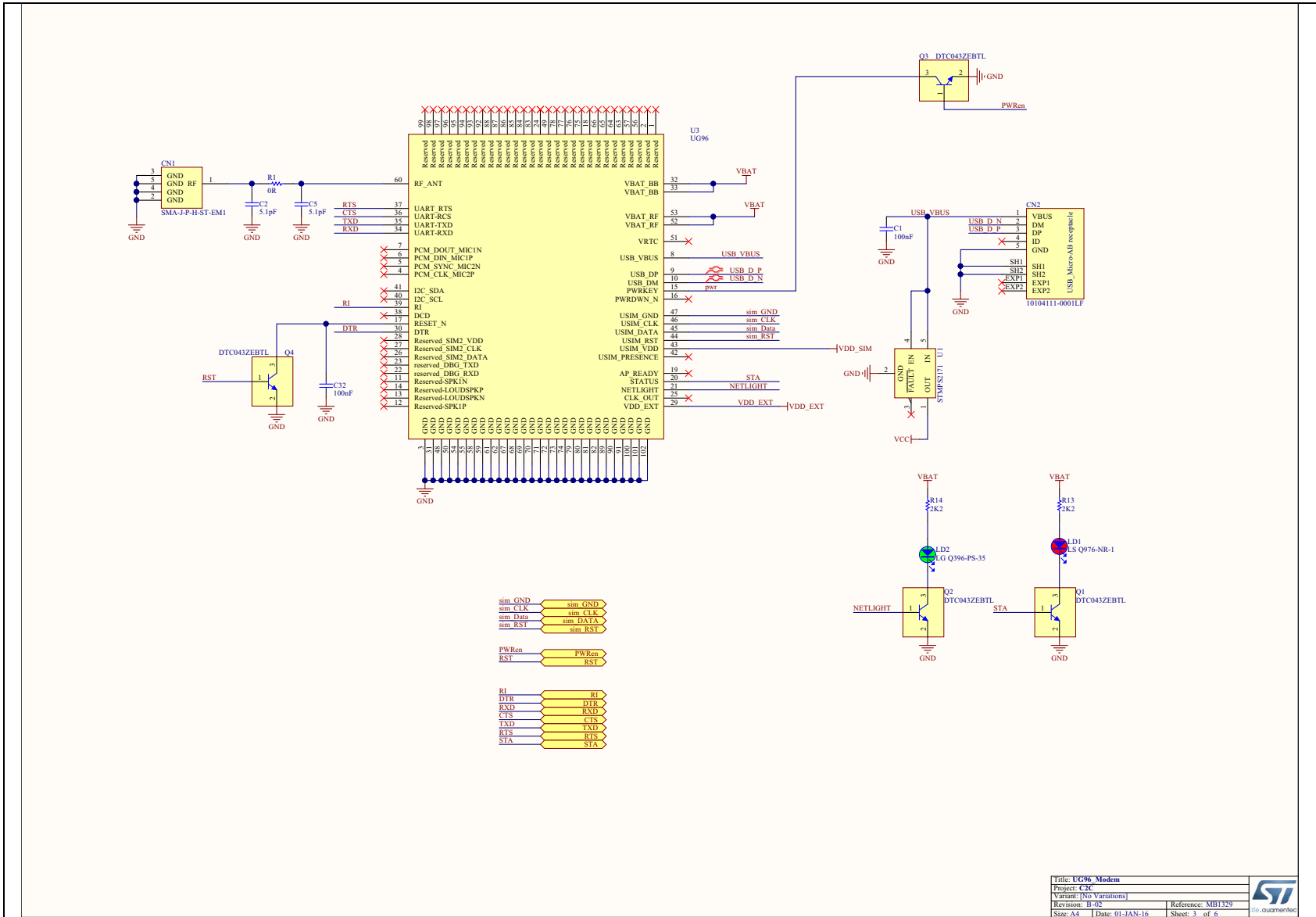


Figure 6. Expansion board modem



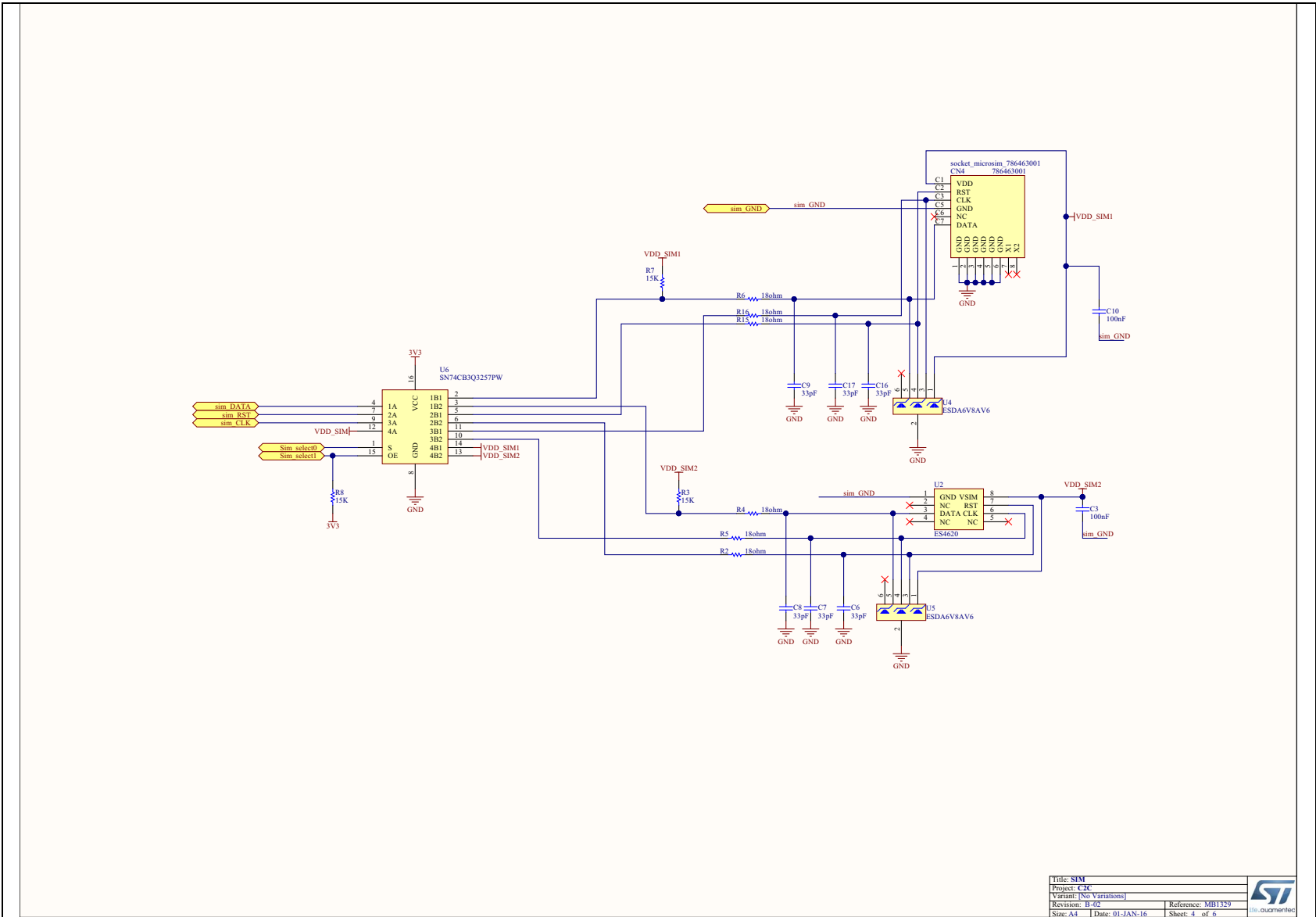
Quectel UG96 and BG96 modem devices are pin-to-pin compatible.

Title: UG96_Modem	
Project: C2C	
Variant: (No variations)	
Revision: B-02	Reference: MBI329
Size: A4	Date: 01-JAN-16
Sheet: 3 of 6	





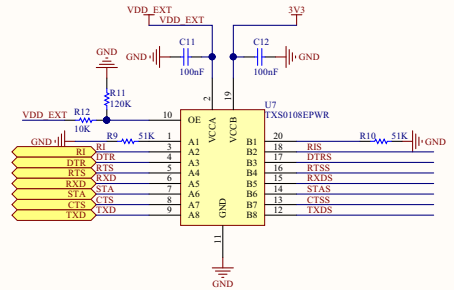
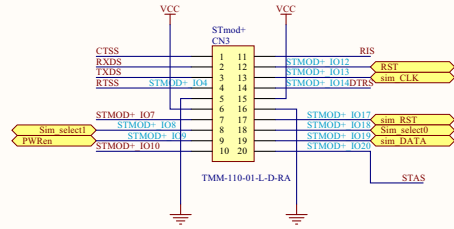
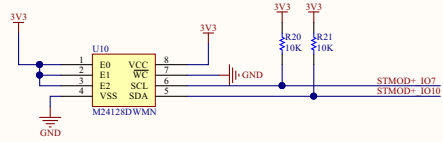
Figure 7. Expansion board SIM



Title:	SIM
Project:	C2C
Variant:	Use Variations
Revision:	B-02
Size:	A4
Date:	01-JAN-16
Reference:	MB1329
Sheet:	4 of 6



Figure 8. Expansion board STMod+

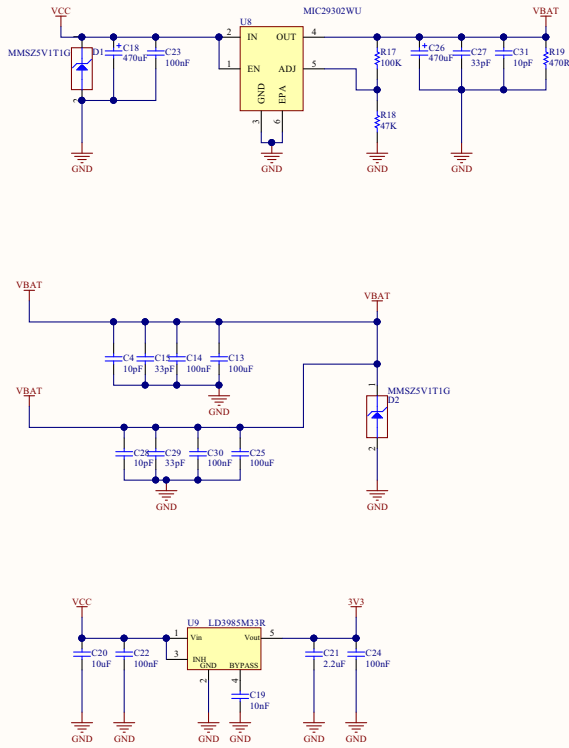


Title: STMOD+	Reference: MBI329
Project: C2C	Sheet: 5 of 6
Variant: (No Variations)	
Revision: B-02	
Size: A4	Date: 01-JAN-16





Figure 9. Expansion board power



Title: Power	
Project: C2C	
Variant: [No Variations]	
Revision: B-02	Reference: MBI329
Size: A4	Date: 01-JAN-16
	Sheet: 6 of 6



Appendix B **Federal Communications Commission (FCC) and Industry Canada (IC) Compliance**

This kit is designed to allow:

1. Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and
2. Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of 47 CFR, Chapter I (“FCC Rules”), the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

Revision history

Table 4. Document revision history

Date	Revision	Changes
1-Mar-2018	1	Initial version
10-Apr-2018	2	Added Chapter 8: P-L496G-CELL02 Information

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